

Submitted to:
US EPA Region 8
Denver, CO

Submitted by:
Atlantic Richfield Company
La Palma, CA
September 7, 2012

Calcines Supplement to Field Sampling Plan for Solids Repository, Permanent Drying Facility and Pond Embankment Improvements

Rico-Argentine Mine Site – Rico Tunnels Operable Unit OU01, Rico, Colorado

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VIA EMAIL AND HAND DELIVERY

September 7, 2012

Mr. Steven Way
On-Scene Coordinator
Emergency Response Program (8EPR-SA)
US EPA Region 8
1595 Wynkoop Street
Denver, CO 80202-1129

**Subject: Calcines Supplement to Field Sampling Plan
Rico-Argentine Mine Site – Rico Tunnels
Operable Unit OU01 Rico, Colorado**

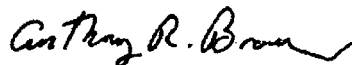
Dear Mr. Way,

A digital file in PDF format of the Calcines Supplement to Field Sampling Plan for Solids Repository, Permanent Drying Facility and Pond Embankment Improvements dated September 7, 2012, is being submitted to you today via email. Three (3) hard copies of the Calcines Supplement to FSP will be hand-delivered to your office no later than September 10.

Atlantic Richfield is submitting the Calcines Supplement to FSP responsive to Tasks B, C, and F of the Removal Action Work Plan, Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01 Rico, Colorado, dated March 9, 2011, accompanying the Unilateral Administrative Order for Removal Action, Rico-Argentine Site, Dolores County, Colorado, US EPA Region 8, Docket No. CERCLA-08-2011-0005.

If you have any questions or comments, please feel free to contact me at (714) 228-6770 or via email at Anthony.Brown@bp.com.

Sincerely,



Anthony R. Brown, P.E.
Project Manager
Atlantic Richfield Company

Enclosure (Supplement to Field Sampling Plan)



Mr. Steven Way
September 7, 2012
Page 2 of 2

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Calclnes Supplement to Field Sampling Plan for Solids Repository, Permanent Drying Facility and Pond Embankment Improvements

**Rico-Argentine Mine Site – Rico Tunnels Operable Unit OU01
Rico, Colorado**

September 9, 2012

1.0 Introduction

AECOM Technical Services, Inc. (AECOM), in cooperation with Anderson Engineering Company, Inc. (AECI) and on behalf of Atlantic Richfield Company (AR), has prepared this Calclnes Supplement to Field Sampling Plan for Solids Repository, Permanent Drying Facility and Pond Embankment Improvements (Calclnes Supplement to FSP) for investigation activities in the vicinity of the St. Louis Ponds system. The work described in this supplement is required to fill identified data gaps related to the leachability of calclnes in the former Ponds 16/17 area.

The work includes the following:

- 1) Sampling of calclnes disposed of in the former Ponds 16/17 area (converted to an interim drying facility for treatment solids removed from Pond 18)
- 2) Geochemical laboratory evaluation of the sampled calclnes

The work is to be performed in the area of the St Louis Ponds, north of Rico, Colorado, within Dolores County at the Rico Tunnels Operable Unit OU01 of the Rico-Argentine Mine Site.

1.1 Purpose

The purpose of this Calclnes Supplement to FSP is to present a scope of work for evaluation of calclnes in the former Ponds 16/17 area and their potential impact on groundwater quality. These activities are responsive to the requirements under Tasks B, C, and F of the Removal Action Work Plan, Rico-Argentine Mine Site – Rico Tunnels Operable unit OU01, Rico, Colorado, dated March 9, 2011 (Work Plan). The results of this study will be used to develop recommendations for mitigating (if needed) impacts to Dolores River water quality from the leaching of calclnes in the former Ponds 16/17 area.

1.2 Organization

Section 1.0 of this Calclnes Supplement to FSP presents the purpose and organization of the plan. Section 2.0 discusses the background and overall objectives of the planned studies. The location and methodology for sampling of the calclnes is discussed in Section 3.0. Geotechnical analysis of the calcline samples is described in Section 4.0. Section 5.0 presents the series of geochemical analyses to be performed on the calcline samples. Section 6.0 describes documentation of the work under this plan. The proposed schedule is discussed in Section 7.0.

2.0 Background and Objectives

Groundwater sampling at the St. Louis Ponds shows that the area of known calcines disposal in Ponds 16/17 has elevated sulfate and metals in groundwater, suggesting that residual sulfides and other material may currently be leaching and loading groundwater in the alluvial aquifer. Mineralogical analysis of samples of calcines recovered from this area showed that calcines are distributed above and below the water table in the alluvial aquifer. Calcines above the water table or at the water table interface containing sulfides may still be oxidizing and providing sulfate and metals to groundwater. Leaching of these calcines is suggested by the low percentage of calcite, compared to calcines recovered below the water table where oxidation and thus leaching is not expected.

Characterization of the leachability of the calcines in the Ponds 16/17 area is planned to better determine the potential loading of metals to groundwater. The leachability of calcines above the water table or at the fluctuating water table interface will be investigated and compared to the leachability of calcines that reside below the water table and can be expected to remain below the water table. The results of the planned investigations at former Ponds 16/17 will be the basis for an initial assessment of leachability at other known areas of calcines disposal onsite.

3.0 Sampling

Calcines will be sampled in the immediate vicinity of borings EB-2 and DH-11 as indicated on Figure 1. At each site, calcines will be sampled at three (3) depth intervals:

- Above the expected maximum elevation of the water table at the site
- At the water table interface
- Below the estimated minimum water table elevation

A tracked excavator with an effective digging reach of 25 feet will be used to retrieve bulk samples of calcines at the sample sites. The tracked excavator will be decontaminated prior to collecting samples at each of the three targeted depths for each sample site. Care will be taken to avoid mixing of material from higher in the excavation with samples taken at greater depths. Safety precautions will be implemented to preclude unauthorized access to the sampling area and to ensure the safety of field personnel.

Calcine samples will be described visually and tested in the field for presence of carbonate minerals using 10% HCL for effervescence. Samples for detailed microscopic examination will be selected and placed in 5-gallon buckets and sealed with a tight lid and tape. Samples for leach testing will be collected in 16-oz. glass containers and packed to minimize the airspace. Care will be taken to ensure the jar rim is clean and the seal is tight. These samples will be kept on ice at 4 degrees Celsius or less during transport to the laboratory.

4.0 Geotechnical Analysis

Each sample collected from both sampling locations will be tested in the geotechnical laboratory for:

- ASTM D2216 – Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D4318 – Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D422 – Standard Test Method for Particle-Size Analysis of Soils
- ASTM D1140 – Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
- ASTM D2487 – Soils for Engineering Purposes (Unified Soil Classification System)

5.0 Geochemical Analysis

All samples will be examined mineralogically, and evaluated for leachability using the US EPA Method 1312 (US EPA 1986; 1994 update). Comparison of the mineralogy and leachability of samples from the three zones at each selected site will aid in estimating:

- The mineralogy controlling leaching of calcines
- Remaining residual leachability of calcines
- Potential buffering and attenuation capacity of calcines

In addition, as directed by AR and AECOM, the following analyses may be conducted after completion of preliminary mineralogical analysis:

- Sequential extractions for exchangeable metals bound to iron and manganese oxides, carbonates, and oxyhydroxides
- Scanning electron microscope (SEM) analysis for physical size of oxide, oxyhydroxide, and sulfide mineral particles
- Total assay analysis

5.1 Synthetic Precipitation Leaching Procedure

The calcine samples will be analyzed by Hazen Research in Golden, Colorado, using the Synthetic Precipitation Leaching Procedure (SPLP), US EPA Method 1312. The Modified US EPA Method 1312 (US EPA 1986; 1994 update) will be used with the standard western SPLP leaching solution. The standard leaching fluid consists of slightly acidified de-ionized water formulated to simulate natural precipitation in southern Colorado. A mixture of 60/40 H₂SO₄/HNO₃ (by weight) will be used to achieve a pH of 5.0 +/-0.05. The SPLP extraction method for 100% solids and no volatiles will be used. Particle size will be reduced to <1 cm if needed for the samples. A ratio by weight of 20:1 extraction fluid to solids will be used on an end-over-end rotary agitator for a minimum of 18 hours. A Zero Headspace Extraction (ZHE) device will be used to minimize oxidation. The decanted extraction solution will be filtered through a 0.7 micrometer borosilicate glass fiber filter using a pressure filtration unit. The filtrate will be preserved for future analysis. A small aliquot of unfiltered leachate will be used for pH, dissolved oxygen (DO), and specific conductivity (SC) analysis. All procedures specified in the US EPA 1312 procedure will be followed.

5.1.1 Sample Analysis

The filtrate preserved for analysis will be analyzed for the constituents listed in Table 1. The pH, DO, and SC of all samples will be determined upon removal from the ZHE device and prior to filtration. All meters will be calibrated prior to use and during use in accordance with the equipment instructions.

Metals: The SPLP solutions extracted will be filtered through a 0.6 to 0.8 micron filter and analyzed for Al, Sb, As, Ba, Be, B, Cd, Ca, Cr, Co, Cu, Fe, Pb, Li, Mg, Mo, Ni, Mn, Mg, K, Se, Si, Ag, Na, Sr, Ti, V, and Zn following the procedures outlined in Table 1. Instrumental Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS) and, for certain analytes, Inductively Coupled Plasma – Atomic Emission Spectroscopy (ICP-AES) will be used. If As and Se are below detection limits, solutions will be preserved for additional analysis by Hydride Generation Atomic Absorption Spectroscopy. Samples will be preserved with nitric acid at a pH less than 1.5 and held for up to 180 days.

Other Constituents: Alkalinity will be determined by titration; ferrous iron will be determined using colorimetric methods; and sulfate, chloride, and fluoride will be determined using ion chromatography or an equivalent method. Preservation of samples for anion analysis requires filtration and refrigeration at 4 degrees Celsius with a hold time of up to 28 days.

5.1.2 Quality Control

Quality control will follow the procedures listed below. Results of the quality control will be presented.

Laboratory Quality Control Checks

Quality Control Check	Frequency	Control Limits
1. Preparation Blank	one per analytical batch	< IDL
2. Analytical Batch Duplicate	one per analytical batch	+/- 20% RPD
3. Reference Standards	one set per analytical group	+/- 20% RPD

Preparation Blank: A preparation blank is a sample of the appropriate volume of extraction fluid that is carried through the entire experimental procedure, including analysis (which includes pH). The blank is used to determine whether added reagents, equipment, procedures, or processes introduce contaminants to the samples. The blank also provides an assurance of the pH of extracting solutions.

Analytical Batch Duplicates: Analytical batch duplicates consist of two (2) identical splits of a site composite that are carried through the entire experimental process, including analysis, to determine the precision of the analysis.

Reference Standards: Reference water standards will be submitted with each group of samples as a check on the analytical method. Standards for major cations and trace metals will be submitted with the sample groups for ICP-MS and ICP-AES analysis.

5.2 Mineralogical Analysis

Microscopic and, as needed, X-ray and/or microprobe analyses of samples will be conducted by Hazen Research under the direction of AR and AECOM personnel. Identification of silicate and carbonate minerals, clays, sulfides, oxides, and non-crystalline materials will be undertaken to characterize the mineralogy of primary and secondary minerals in the calcine samples collected for geochemical analysis. Laboratory implementation plans for mineralogical analyses will be prepared by Hazen for review and approval by AR, AECOM, and EPA as work progresses and different mineralogical analyses are deemed needed for calcine characterization.

5.3 Additional Chemical Analysis

Column leaching studies to evaluate the sequential leaching of the calcines and column attenuation studies to assess the attenuation of leachate by calcines below the water table may also be completed. The column leaching studies would evaluate the leaching of calcines found above or at the water table and would provide an assessment of the changes in leachate chemistry with time and the passage of each pore fluid during leaching. The leachates from the column leaching evaluations would then be passed through calcines from below the water table to determine the possible natural attenuation of the leachates. The overall goal of the column leaching and attenuation studies would be to determine the potential for natural attenuation of leachate from the calcines in the Ponds 16/17 area.

Sequential extractions for exchangeable metals bound to iron and manganese oxides, carbonates, and oxyhydroxides; scanning electron microscope (SEM) analysis for physical size of oxide, oxyhydroxide, and sulfide mineral particles; and total chemical assay analysis may be conducted after completion of mineralogical analysis and column leaching studies. The goal of the sequential extractions would be to determine where metals of concern, such as cadmium and zinc, are held in the calcines. The total chemical analysis would provide the data needed for an overall understanding of the calcine mineralogy and chemistry.

Static Acid-Base Accounting (Static ABA) analysis will be completed on calcines from above the water table, at the water table interface, and below the water table at each sample site. The Static ABA tests will be conducted following the procedures outlined in Sobek, et al. (1978) found in EPA publication 600/2-78-054. Both total sulfide and pyritic sulfide will be evaluated and the acid-generating potential (AGP) will be calculated based on both total and pyritic sulfide. In addition, the net neutralizing potential (NNP) will be calculated based on total and pyritic sulfide. The Static ABA results would be combined with the EPA 1312 and the column leaching studies for an overall understanding of the chemical reactivity of the calcines and their potential for acid generation, leaching, and natural attenuation of the leachate by calcines currently below the water table in the Ponds 16/17 area.

6.0 Documentation

Upon completion of the overall study, the methodology, results, and interpretation of the data will be presented in a Final Technical Memorandum to the EPA.

7.0 Schedule

The proposed schedule for implementation of the sampling, analyses, and documentation of the calcines geochemical studies is as follows:

- Field sampling completed by September 30, 2012
- Complete EPA 1312 and Static ABA testing by November 15, 2012
- Mineralogical and chemical analyses will be performed concurrently with EPA 1312 and Static ABA tests and completed by December 15, 2012
- Final Technical Memorandum to EPA by January 31, 2013



TABLES

Table 1: Analytical Parameters and Procedures Summary

Parameter	Minimum Detection Limit (MDL)	Method
Field Parameters		
pH (s.u.)	+/- 0.01 pH	EPA 150.2
Temperature	+/- 1°C	Standard Method 2550
Conductivity (µmhos/cm)	+/- 2% Full Scale	EPA 120.1
Dissolved Oxygen	+/- 2% Full Scale	SM 4500-OG
ORP (Redox Potential)	N/A	Ag/AgCl Probe
Non-Metals		
Alkalinity (mg/L as CaCO ₃)	RL – 20 mg/L	EPA 310.1
Hardness (mg/L as CaCO ₃)	RL – 0.5 mg/L	SM 2340B
Total Dissolved Solids	RL – 5.0 mg/L	SM 2540C
Total Organic Carbon	0.5 mg/L	EPA 415.1
Total Suspended Solids	RL – 5.0 mg/L	SM 2540D
Bicarbonate	TBD	SM 2320B
Cyanide	RL – 0.005 mg/L	EPA 335.4
Fluoride	TBD	EPA 300.0
Nitrate	TBD	EPA 300.0
Salinity	RL – 6 mg/L	SM 2510B (calculated)
Silica	0.1 mg/L	ASTM D859
Sulfate	RL – 1 mg/L	EPA 300.0
Sulfides	0.05 mg/L	EPA 376.2
Total and Dissolved Metals		
Aluminum	2 µg/L	EPA 200.8
Antimony	0.07 µg/L	EPA 200.8
Arsenic	0.09 µg/L	EPA 200.8
Barium	0.08 µg/L	EPA 200.8
Beryllium	0.02 µg/L	EPA 200.8
Cadmium	0.03 µg/L	EPA 200.8
Calcium	10 µg/L	EPA 200.8
Chromium	0.25 µg/L	EPA 200.8
Cobalt	0.05 0 µg/L	EPA 200.7
Copper	0.07 µg/L	EPA 200.8
Iron	4.67 µg/L	EPA 200.8
Lead	0.05 µg/L	EPA 200.8
Magnesium	2.5 µg/L	EPA 200.8
Manganese	0.17 µg/L	EPA 200.8
Mercury	0.049 µg/L	EPA 245.1
Nickel	0.07 µg/L	EPA 200.8
Potassium	10 µg/L	EPA 200.8
Selenium	0.22 µg/L	EPA 200.8
Silver	0.25 µg/L	EPA 200.8
Sodium	25 µg/L	EPA 200.8
Thallium	0.05 µg/L	EPA 200.8
Vanadium	0.05 µg/L	EPA 200.8
Zinc	2.5 µg/L	EPA 200.8



FIGURES

ANSI B 11" x 17" Approved Checked Designer Project Management Initials Last Issued by: RODENBA Last Printed: 8/7/2012
File name: I:\USDEN\APPROVAL\COM_PROJECTS_CURRENT_PROJECTS\ATLANTIC RICHFIELD\50157757 RICO\000_CADD\06-EXHIBITS\20-CALCINES SUPPLEMENT\20-CALCINES_FIG_1_SAMPLING_LOCATIONS_REV001.DWG 1:57 PM

